

BIOVISION

UNLOCKING LIFE SCIENCES

GRADE 12



BIOVISION UNLOCKING LIFE

SCIENCE GRADE 12

"Where Wonder Meets Knowledge."



Contributor



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Motivational Message

Dear Learner,

You can achieve greatness! Every page you turn and every concept you master brings you closer to success. Let this journey through Life Sciences ignite your curiosity and strengthen your determination. Remember, your future is in your hands — and it begins with belief in yourself. Stay focused, stay hungry, and never give up! I, **Anani Bova**, wish you nothing but success, strength, and a bright future. May this guide help you rise above challenges and reach your full potential.

What This Study Guide Will Do for You

This study guide is designed to make Grade 12 Life Sciences easier to understand and more engaging. It will:

- **Break down complex topics into simple explanations.**
- **Provide key definitions, diagrams, and examples for better learning.**
- **Help you prepare for exams with summaries, questions, and tips.**
- **Build your confidence and deepen your knowledge of the living world.**

Let **BioVision: Unlocking Life Sciences** be your learning companion — clear, reliable, and focused on your success.

Life's Building Blocks: From Biochemistry to Multicellular Systems

MITOSIS: CELL DIVISION

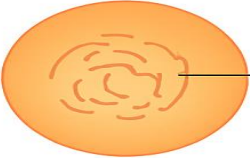
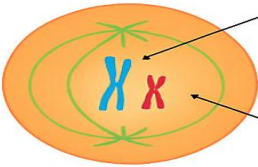
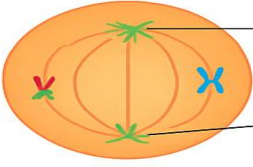
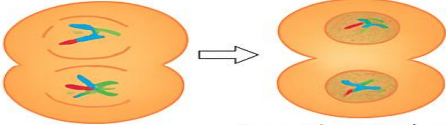
Chromosome	A thread-like structure made of DNA and protein found in the nucleus, carrying genetic information in the form of genes.
Chromatid	One of the two identical strands formed after DNA replication, making up a replicated chromosome.
Centromere	The region of a chromosome where two sister chromatids are joined.
Homologous chromosomes	A pair of chromosomes, one from each parent, that are the same size and have the same gene location.
Bivalent	A pair of homologous chromosomes physically paired during Prophase I of meiosis, allowing for crossing over.
Unreplicated chromosome	A chromosome consisting of one double-stranded DNA molecule.
Replicated chromosome	A chromosome consisting of two identical chromatids joined at the centromere.
Interphase	The phase of the cell cycle in which DNA replication occurs before cell division.
DNA replication	The process of producing an identical copy of DNA before cell division.
Diploid (2n)	A cell that contains two complete sets of chromosomes.

Haploid (n)	A cell that contains only one set of chromosomes.
Gene	A segment of DNA on a chromosome that codes for a specific protein or trait.
Centrosome	An organelle found in animal cells that organizes spindle fibres during cell division.
Centriole	A cylindrical structure in animal cells that helps form the spindle apparatus.
Spindle fibres	Protein threads that attach to chromosomes and pull them apart during cell division.
Crossing over	The exchange of genetic material between homologous chromosomes during Prophase I of meiosis.
Chiasma	The physical point where chromatids of homologous chromosomes overlap during crossing over.
Karyotype	A diagram showing the number, size, and shape of chromosomes in a somatic cell.
Autosome	Any chromosome that is not a sex chromosome (pairs 1–22 in humans).
Gonosomes (Sex chromosomes)	The pair of chromosomes (XX or XY) that determines the biological sex of an individual.
Somatic cell	All body cells except sex cell.
Gamete (Sex cell)	A haploid reproductive cell (sperm or egg) formed through meiosis.
Non-disjunction	The failure of homologous chromosomes or sister chromatids to separate properly during meiosis.
Karyokinesis	The division of the nucleus during cell division.
Cytokinesis	The division of the cytoplasm after nuclear division.

STAGES OF MITOSIS

Four phases can be distinguished during mitosis

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase

Interphase  Chromatin	• DNA replication occurring to this itase pase • Chromatin network consists of two chromatids joinec oy ra centromere
Metaphase  spindmse chromosome	• Chromosomes move to the equator and arrange themsselves in a single row on the equator • Each chromosome is attached to spindle fibres at its centrome
Anaphase  chromatids at poles spindle fibre	• The centromere of each chromosomes divide into two • Two chromatids separate and pulling the chromatis move to opposotes poles
Telophase  Two identical cells	• The chromatids now called chromosomes arrange themselves at thepoles • The spindle fibres disappear • Nuclear membrane formas around each grouf of chromosomes at each pole and a nucleolus • Cytoolasm divides

The role of mitosis:

- Development and growth
- Reproduction
- Cell replacement
- Replacement of damaged tissues

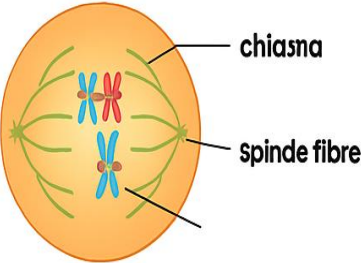
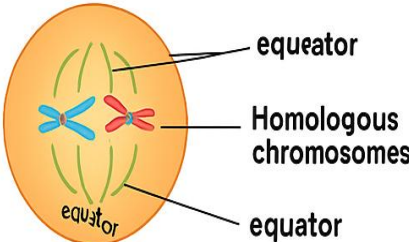
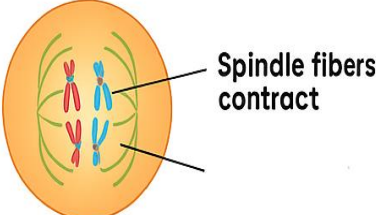
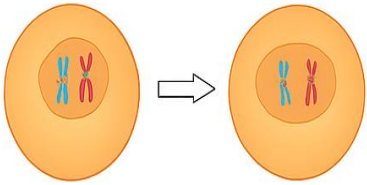
MEIOSIS

Meiosis – A type of cell division that occurs in sex organs to produce gametes (sperm and egg), where one diploid cell divides to form four genetically different haploid cells, each with half the number of chromosomes of the original cell.

Two stages of meiosis:

- Meiosis 1
- Meiosis 2

MEIOSIS 1

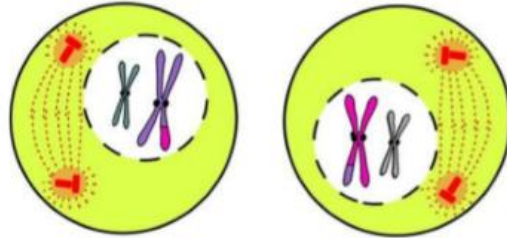
Prophase I		• Homologous chromosomes pair up (synapsis) • Crossing over occurs at chiasmata • Spindle fibers form • Nuclear membrane breaks down
Metaphase I		• Homologous chromosomes line up along the equator • Each pair attaches to spindle fibers by centromeres
Anaphase I		• Spindle fibers contract • Homologous chromosomes move to opposite poles
Telophase I		• Nuclear membranes may reform • Cytoplasm divides (cytokinesis) • Two haploid daughter cells are formed

Meiosis II

Prophase II

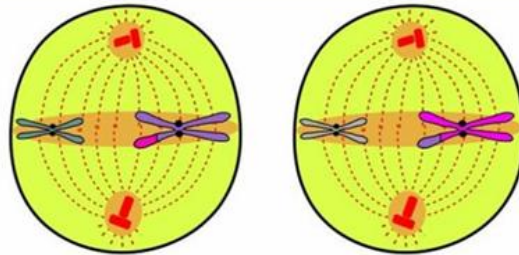
- Nuclear membrane and nucleolus start to disappear.
- Centrosome splits into two centrioles and a spindle forms.
- Chromosomes are NOT in pairs

Remember: Each chromosome is made of TWO chromatids



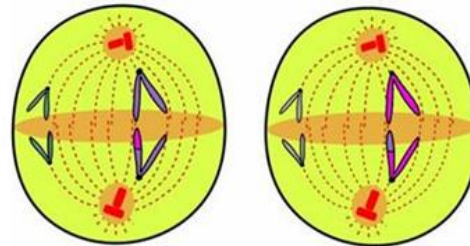
Metaphase II

- **Single chromosomes arrange themselves randomly along the equator** with the centromere in line with the equatorial plane.
- Which chromatid faces which pole is totally up to chance.
- Each chromosome becomes attached to a spindle fibre.



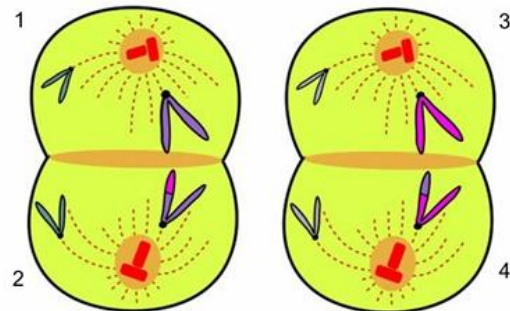
Anaphase II

- Centromere splits separating each chromosome into two **daughter chromosomes**, each pulled to opposite poles.

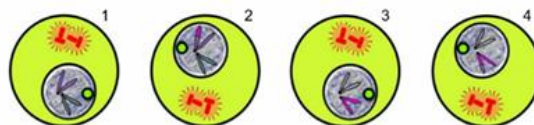


Telophase II

- A new nuclear membrane forms around the **unreplicated chromosomes** at each pole
- **Cytokinesis** splits the cell into two new cells



Important: As Meiosis II took place in **TWO** cells, there will now be **FOUR** daughter cells. These cells will be **haploid** and **genetically different** to each other.



Site of meiosis in plants and in animals

Meiosis is a cell division that usually takes place in the sex cells.

- In plants, meiosis occurs in the **anther** to produce pollen grain and in the **ovary** to produce the ovule.
- In humans, meiosis occurs in the **testis** to produce sperms and in the **ovary** to produce an ovum.

Importance of meiosis

- Production of gametes (four daughter cells are formed).
- Halving of the chromosome number (diploid to haploid) so that the chromosome number remains constant from generation to generation within a species.

Mechanism to introduce genetic variation through:

- Crossing over during Prophase I.
- The random arrangement of chromosomes at the equator during Metaphase I and II

Differences between meiosis I and meiosis II

Meiosis I	Meiosis II
Chromosomes arrange at the equator of the cell in homologous pairs	Chromosomes line up at the equator of the cell individually
Whole chromosomes move to opposite poles of the cell	Chromatids move to opposite poles of the cell
Two cells are formed at the end of this division	Four cells are formed at the end of this division
The chromosome number is halved during meiosis I (diploid → haploid)	The chromosome number remains the same (haploid) during meiosis II
Crossing over takes place	Crossing over does not take place

Comparing mitosis and meiosis

Mitosis	Meiosis
Mitosis occurs in body cells	Meiosis occurs in sex organs
Both karyokinesis and cytokinesis occurs once	Both karyokinesis and cytokinesis occurs twice
Two daughter cells are formed	Four daughter cells are formed
Daughter cells are genetically identical to one another and to the parent cell	Daughter cells are genetically different from each other and from the parent cell
Chromosome number remains constant	Chromosome number is halved
Crossing over does not occur	Crossing over occurs

PROCESSES

CROSSING OVER:

- During Prophase I, homologous chromosome pairs up
- Each chromosome consists of two chromatids
- Chromatids overlap at a point called chiasmata/chiasma
- Genetic material is exchanged between the chromatids.
This exchange results in new combinations of genetic material

Press to watch a video <https://youtu.be/MTVhlixb7D8>

RANDOM ARRANGEMENT OF CHROMOSOMES

Occurs during Metaphase I and Metaphase II of meiosis.

Homologous chromosomes line up randomly at the equator of the cell.

This random arrangement ensures they separate independently during anaphase.

As a result, the gametes receive different combinations of chromosomes, further increasing genetic variation.